

# Circular Dichroism

Synchrotron Ultraviolet User Facility

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# Scientific Need

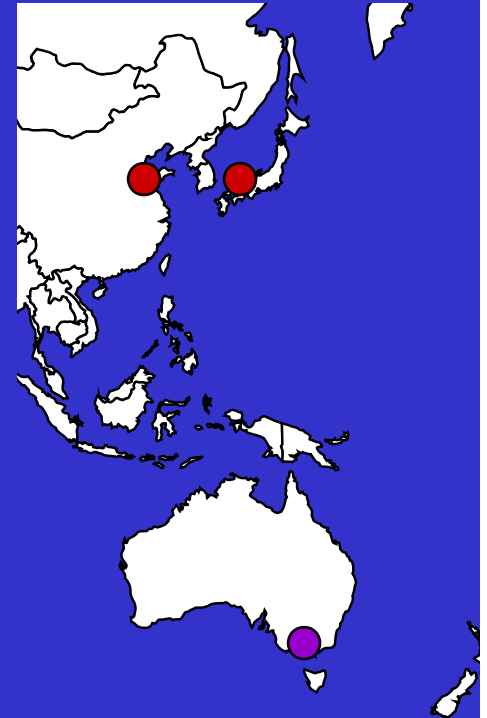
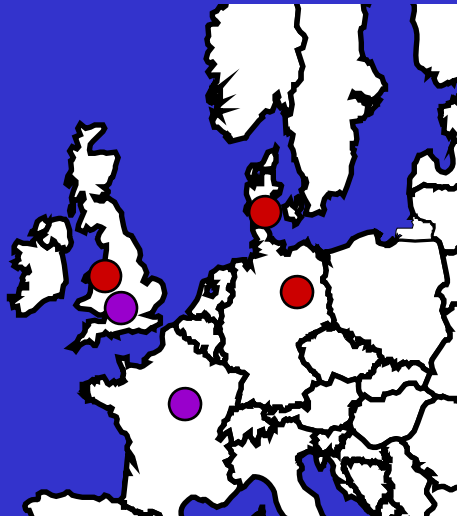
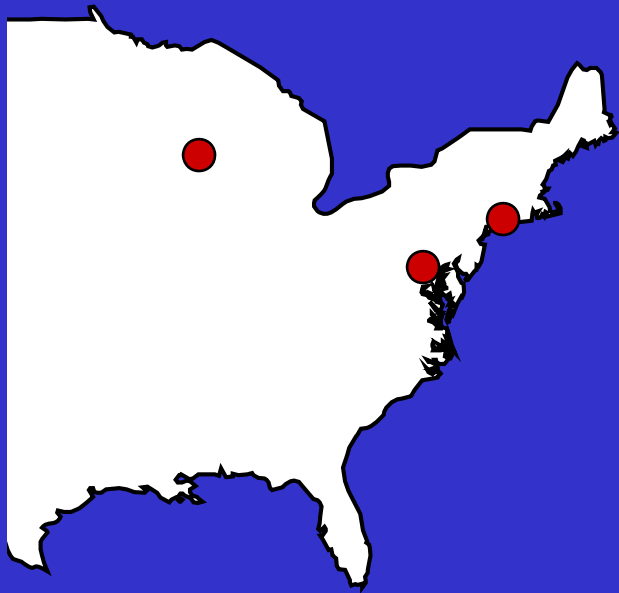
- Circular Dichroism in the UV provides information of the structure and dynamics of Biological Macromolecules (proteins, DNA, RNA) that complements MX
- Particularly useful for systems such as membrane-bound proteins that are difficult to crystallize
- Dynamic information from rapid-mixing (“stopped flow”) experiments (to  $< 1$  ms)
- Synchrotron radiation CD (SRCD) significantly improves quality of data and extends range of measurements for  $\lambda < \sim 200$  nm ( $h\nu > 6$  eV) compared to conventional sources

# User Demand

- NSLS 2007
  - (alignment and calibration not included)
  - U11: 165 days
  - U9B: 48 days
- Workshops:
  - ~ 15 students/y
  - International faculty
  - BioCD-2005
  - BioCD-2007
  - BioCD-2008
- Worldwide: SRCD at facilities in Europe, Asia and Australia



# Synchrotron Radiation UV Circular Dichroism Beamlines



- Structural Biology
- Solution structure of proteins, DNA & RNA
  - Membrane proteins
- Time resolved (stopped-flow)

# NSLS-II SRCD Beamline

- Front-end (high horizontal acceptance)
- Support structure
- Components from U11

# SRCD at NSLS-II

- Primary Beamline (1):

- Bending Magnet Radiation
- Normal Incidence Monochromator
- End Stations (interchangeable)
  - Non-vacuum (purged) primary (to  $< 140$  nm)
    - CD/absorption of solution samples
    - Ultra-short  $\text{CaF}_2$  path-length sample cells
    - Couette cell for flow-induced LD available
  - Stopped flow
  - UHV secondary
    - absorption spectroscopy for material science and gas phase users
    - $\lambda < 80$  nm
  - Superconducting magnet for gas phase MCD (?)
- Signal Processing
  - CD
  - Absorption: simultaneous with CD & LD or stand-alone
  - LD: characterization of oriented samples

- Secondary Beamlines: none

# Current NSLS Program

- U11
  - Wadsworth normal incidence monochromator
  - Purged sample chamber
  - UHV sample chamber
  - Will be upgraded and moved to NSLS II
- U9B
  - Original SRCD beamline
  - Czerney-Turner monochromator
  - Stopped-flow CD (to NSLS II)
  - Fluorescence detection systems
  - Will not move to NSLS II

# Upgraded NSLS SRCD at U11

- Monochromator
  - All new optics (mirror and grating): **In progress**
  - New vacuum pumps
  - New stepping motor wavelength drive system
- Computer system
  - Replace
  - Use NSLS II standards
- Kinematic system for interchanging end stations

# Transition Timeline

assumes front end supplied by facility

- 2 to -1.5: Design support structure
- 1.5 to -1: Fabricate support structure
- 1 to -0.5: Install support structure
- 0.5 to 0: Move alternate end stations and support equipment
- 0 to +0.5: Move beamline components & begin commissioning
- 0.5 to 1: Complete commissioning and transition to routine operations

# Laboratory / Office Space

- Laboratory:
  - Facilities for handling biochemical samples (shared): running water, distilled water, water ice, glassware and facilities for cleaning same, table-top centrifuges, biochemical supplies (store-room), spectrophotometer...
  - Technical support specialists[s] to manage these resources
- Office:
  - Space for 2 permanent beamline staff plus 2 concurrent visitor groups
  - Proximity to MX, IR and other biological beamlines/groups

# Funding

- DOE/BER
  - Continuing program
  - Increased funding to support higher throughput